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DEL S. CHRISTENSEN — February 27, 2002 (Date of Signature)

PATENT
TH1042 (US)
DSC

THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Rashmi K. Shah et al.

Serial No. 09/168,770

Filed OCTOBER 8, 1998

FLAMELESS COMBUSTOR PROCESS HEATER

GROUP ART UNIT 1764

EXAMINER: F. VARCOE Jr.

February 27, 2002

ASSISTANT COMMISSIONER FOR PATENTS
Washington, DC 20231

Sir:

APPELLANT'S BRIEF

The following brief in on appeal of a final rejection of claims of the above-identified U.S. patent application, the final rejection contained in an Office action mailed on October 10, 2001, and a notice of appeal was mailed by applicant on January 9, 2002. This brief is filed in triplicate. Please charge the fee for filing of this brief to Shell Oil Company Deposit Account No. 19-1800. It is respectfully requested that the Board consider the following arguments and reverse the final rejection of claims 1-7 and 13-15 in the above-identified application.

REAL PARTY IN INTEREST

The invention of the present application is assigned to Shell Oil Company, which is the real party of interest in the present appeal.

RELATED APPEALS AND INTERFERENCES

Appellant, and appellant's legal representative, are not aware of any appeals or interferences that directly affect or could directly be affected by or have a bearing on the Board's decision in the present appeal.

STATUS OF THE CLAIMS

Claims 1-7 and 13-15 stand as finally rejected under 35 U.S.C. §102(b).

STATUS OF AMENDMENT

There are no amendments filed herewith or outstanding with respect to this application.

SUMMARY OF THE INVENTION

The present invention relates to a process heater utilizing flameless combustion, the process heater includes: an oxidation reaction chamber, the oxidation reaction chamber having an inlet for oxidant, an outlet for combustion products, and a flow path between the inlet and the outlet; a fuel conduit capable of transporting a fuel mixture to a plurality of fuel nozzles within the oxidation reaction chamber, each nozzle providing communication from within the fuel conduit to the oxidation chamber, with each nozzle along the flowpath between the inlet and the outlet; a preheater in communication with the oxidation chamber inlet, the preheater capable of increasing the temperature of the oxidant to a temperature resulting in the combined oxidant and fuel from the fuel nozzle closest to the oxidation chamber inlet being greater than the autoignition temperature of the combined oxidant and fuel from the fuel nozzle closest to the oxidation chamber inlet; and a process chamber in a heat exchange relationship to the oxidation chamber wherein the heat transferred from the oxidation chamber does not cause the temperature of the mixture within the oxidation reaction chamber in the vicinity of each fuel nozzle to decrease below the auto ignition temperature of the combined mixture in the oxidation chamber in the vicinity of that fuel nozzle and the fuel nozzles are capable of distributing fuel into the oxidation chamber without forming a flame..

The specification describes how flameless combustion is accomplished. Combustion air and fuel gas are preheated to above a temperature at which when the two streams are combined the temperature of the mixture exceeds the autoignition temperature of the mixture, but to a temperature less than that which

would result in the oxidation upon mixing being limited by the rate of mixing. Further, flameless combustion is maintained by the design of the fuel nozzles and oxidation chamber so that the fuel and air velocities are high enough to blow off any stabilized flame. Recirculation or low-velocity regions where a flame could attach to the fuel nozzle are also avoided. Preheating of the streams to a temperature between about 850C and about 1400C and then mixing the fuel gas into the combustion air in relatively small increments can result in flameless combustion. The nozzles are spaced so that fuel is added to the oxidation reaction chamber at a rate that results in the flow of fuel through each nozzle not resulting in a flame as the fuel mixes with the oxidation stream flowing through the flowpath of the oxidation chamber. The fuel, rather than burning with a luminous flame, will react with oxidant in a relatively uniform manner throughout the volume of the oxidation chamber.

Flameless combustion in the process heater of the present invention allows operation at considerably higher average heat transfer temperatures than those obtainable with fired heaters do to the avoidance of flames as radiant heat sources.

ISSUE

Whether Ruhl, EP 0 450 872 A1 anticipates claims of the present application.

GROUPING OF CLAIMS

The claims stand or fall together.

ARGUMENTS

The claims stand as rejected under 35 U.S.C. §102(b) based on Ruhl. Ruhl discloses a reactor that has a configuration with a burner in the center of a vessel containing catalyst. As the Examiner indicates in the office action, "Ruhl's Figure 1 appears to show a flame, and the reference number 50 is used to indicate a "flame zone". Further, on page 5, line 55, and on page 6, line 4,"autoignition" of the burner is referred to, confirming that a flame is envisioned.

Claim 1 of the present application (the only remaining independent claim) requires that fuel nozzles are capable of distributing fuel without a flame forming. The present specification, on page 6, lines 1-8, requirements for maintaining a flameless combustion are discussed. Preheating reactants is needed to maintain flameless combustion, but rapid mixing and high enough nozzle velocities are needed to keep any flame blown off the nozzle. Recirculation or low-velocity regions need to be avoided. Small increments of fuel are added, and a preheat is temperature of 850°C to 1400°C is used in the present invention.

In an Office action mailed on October 9, 2001, the Examiner explains the rejection over Rahl as being based on there being no structural element added by the requirement that the apparatus of the present invention requiring flameless combustion. 35 C.F.R. §112, sixth paragraph provides that apparatus elements can be functionally defined. In the present application, it is required that the fuel is burned in flameless oxidation chamber. The specification specifies how this is accomplished. The size and orientation of the nozzles, which are functionally defined, are structural limitations. Ruhl may provide nozzles for fuel that appear in schematic drawings to be similar to the nozzles of the present invention, but persons of ordinary skill in the art would not know from Ruhl to design nozzles that would result in flameless combustion, and in fact, would be directed away from such a structure. Although the Ruhl reference discloses a reactor that looks similar to the reactor of the present invention, sizing and placement of nozzle orifices to avoid creation of flames is taught in the present application, required by the claims subject to the final rejection, and is not taught or suggested by Ruhl. Thus, a rejection of the present claims under either 35 U.S.C. §102 or 35 U.S.C. §103 is improper and the present rejection is respectfully traversed.

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CONCLUSION

For the reasons set forth above, the applicants assert that the rejections made by the Examiner are improper. Applicants therefore request that the Board reverse the Examiner's rejections, and allowance of the claims is respectfully requested.

Respectfully submitted,

Rashmi K. Shah et al.

By: [signature]

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Enclosure: Triplicate copies of Petition with appendix of claims

APPENDIX

Claims under Appeal

US 09/168,770

1. A process heater comprising:

an oxidation reaction chamber, the oxidation reaction chamber having an inlet for oxidant, an outlet for combustion products, and a flow path between the inlet and the outlet;

a fuel conduit capable of transporting a fuel mixture to a plurality of fuel nozzles within the oxidation reaction chamber, each nozzle providing communication from within the fuel conduit to the oxidation chamber, with each nozzle along the flowpath between the inlet and the outlet;

a preheater in communication with the oxidation chamber inlet, the preheater capable of increasing the temperature of the oxidant to a temperature resulting in the combined oxidant and fuel from the fuel nozzle closest to the oxidation chamber inlet being hotter than the autoignition temperature of the combined oxidant and fuel from the fuel nozzle closest to the oxidation chamber inlet; and

a process chamber in a heat exchange relationship to the oxidation reaction chamber wherein the heat transferred from the oxidation chamber does not cause the temperature of the mixture within the oxidation chamber in the vicinity of each fuel nozzle to decrease below the autoignition temperature of the combined mixture in the oxidation chamber in the vicinity of that fuel nozzle and the fuel noxxles are capable of distributing fuel into the oxidation chamber without forming a flame.

2. The process heater of claim 1 further comprising a coke inhibitor injection system, the coke inhibitor system in communication with the fuel supply conduit wherein an amount of coke inhibitor supplied can be effective to inhibit coke formation at fuel conduit operating temperatures.

3. The process heater of claim 1 wherein the fuel conduit is a tubular conduit essentially centrally located within the oxidation reaction chamber.

4. The process heater of claim 3 wherein the oxidation reaction chamber is essentially centrally located within the process chamber.

5. The process heater of claim 1 wherein the process chamber is a pyrolysis reaction chamber for the production of olefins.

6. The process heater of claim 1 wherein the process chamber is effective as a steam methane reforming reaction chamber.

7. The process heater of claim 1 wherein the process heater is a ethylbenzene dehydrogenation heater.

13. The process heater of claim 1 wherein the process comprises an endothermic chemical reaction.

14. The process heater of claim 1 wherein the process is a vacuum flash distillation feed heater.

15. The process heater of claim 1 wherein the process is a hydrocarbon distillation column reboiler